Westinghouse Electric & Mfg. Co.,

PITTSBURG, PA.,

for North America, South America (except British and French Possessions), Cuba, Puerto Rico, Hawaiian Islands, Philippine Islands, China (except British Possessions and Dependencies) and Japan.

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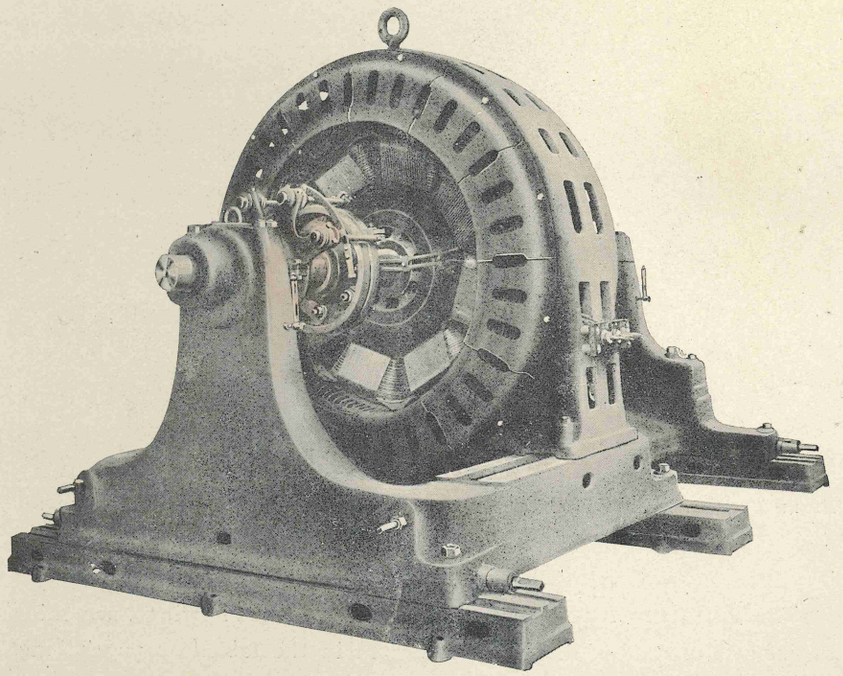
& Manufacturing Co.

PITTSBURG, PA.

Circular No. 1076. March, 1904.

REVOLVING FIELD ALTERNATORS WITH BEARINGS

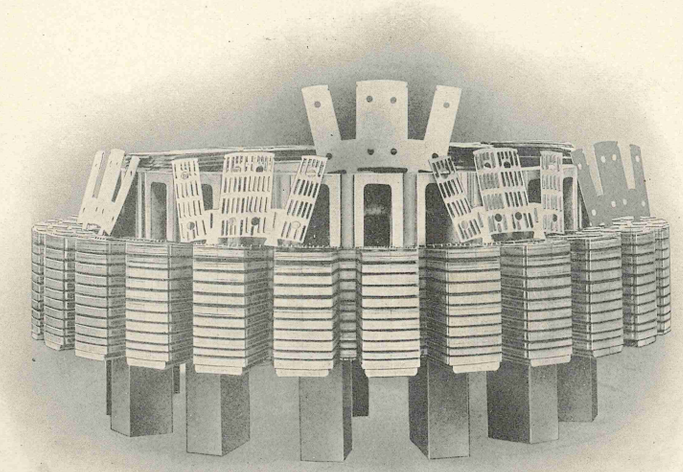


THREE-BEARING REVOLVING FIELD ALTERNATOR, THREE-PHASE 400 K.W., 3000 ALTERNATIONS, 2200 VOLTS

In dynamos of this type the current is generated in coils wound on a stationary armature and connected directly to the supply circuits without the interposition of moving contacts of any kind. Insulation for high voltages can be more readily applied to coils which are stationary and therefore not subjected to the mechanical strains unavoidable in armatures

of the revolving type. The absence of collectors and brushes in the main circuits is particularly advantageous in machines of large current capacity or high potential.

Westinghouse revolving field alternators are designed for two or three phase, 60 and 25 cycles. Standard generators are wound for 220, 440, 1100 and 2200 volts, two or three phase, and 6600 volts, three phase. Windings for other potentials and frequencies may also be obtained to meet special conditions.



FIELD CORE OF A REVOLVING FIELD ALTERNATOR IN COURSE OF CONSTRUCTION

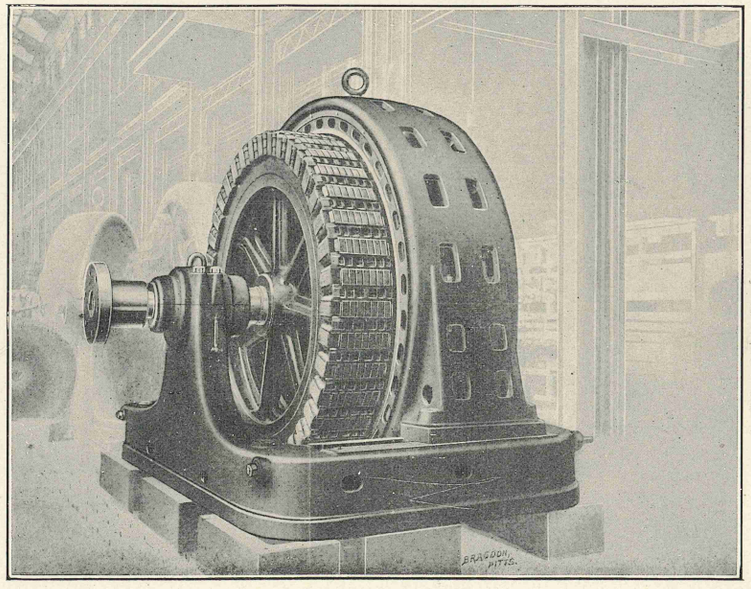
DESCRIPTION

The armature frames are made for two or three bearings, according to size and method of driving as indicated in the tables on pages 9 and 10. Two bearing machines of any size may be arranged for direct connection to engine or water wheel, or in sizes up to and including 200 K.W. for driving by belt. To reduce the strain on bearings and shaft, belt driven generators above 200 K.W. capacity are provided with three bearings.

The bearings of the 60 cycle generators from 30 to 200 K.W. capacity are supported by end brackets which are bolted to the armature frame, a

construction similar in general to that used with our Type C induction motors.

The bed plates of the larger generators are extended and means provided so that the armature may be moved parallel to the shaft. Easy access to field and armature windings, without disconnecting or disturbing the windings themselves, is thus provided, as shown by illustration below.

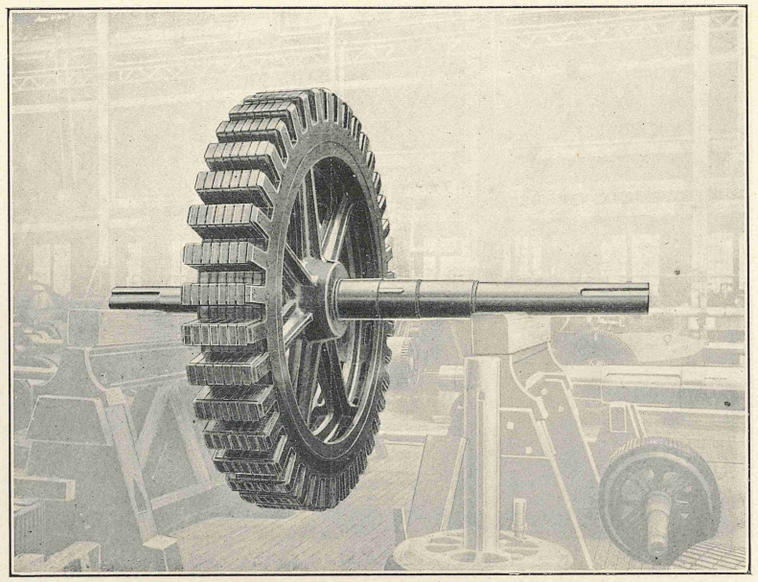


TWO BEARING REVOLVING FIELD GENERATOR WITH ARMATURE DISPLACED

Field—A laminated ring of thin steel punchings clamped together by bolts is built up around and securely dovetailed into a cast iron spider. The punchings are so assembled as to break joints at center of poles, a construction which secures the best possible magnetic circuit and great mechanical strength. The cast iron spider forms no part of the magnetic circuit, the lines passing only through the soft sheet steel, which is especially treated and of the highest quality. This construction also provides a rim with great strength, sufficient to resist the strains due to centrifugal force without bringing any undue stress upon the central spider, whose only function is to hold it in proper position. It constitutes, in

fact, a self supporting laminated steel rimmed fly-wheel. There is also no possibility of the poles becoming loose.

The Field Coils are machine wound upon suitable forms. Wire is used for the smaller sizes, but in the larger machines copper strap, bent on edge and afterwards insulated, is usually employed. This form of coil is practically indestructible. The illustration on page 6 shows a field of this type, with coils in position. Retaining wedges of copper with

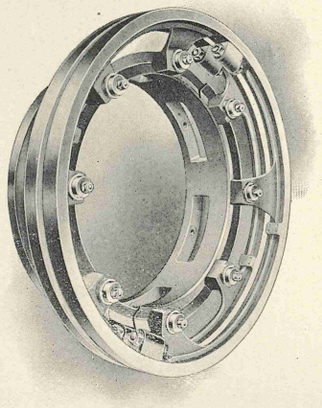


Field Core Showing Ventilating Spaces

large external lips overhanging the beveled edges of the pole pieces hold the coils securely in place and also act powerfully as "dampers" to retard any shifting of the field across the pole faces. The latter effect is of great importance as it reduces "pumping" between generators and rotary converters or synchronous motors, and simplifies the problem of parallel operation.

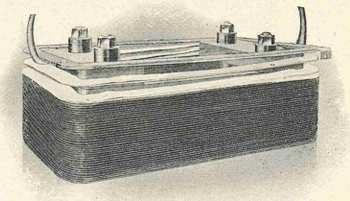
The field coils are connected to the exciting circuit through collector rings of the ventilated or spider type, illustrated on opposite page.

Carbon brushes make contact over the entire width of the rings, thus assuring even wear and a total absence of grooving.



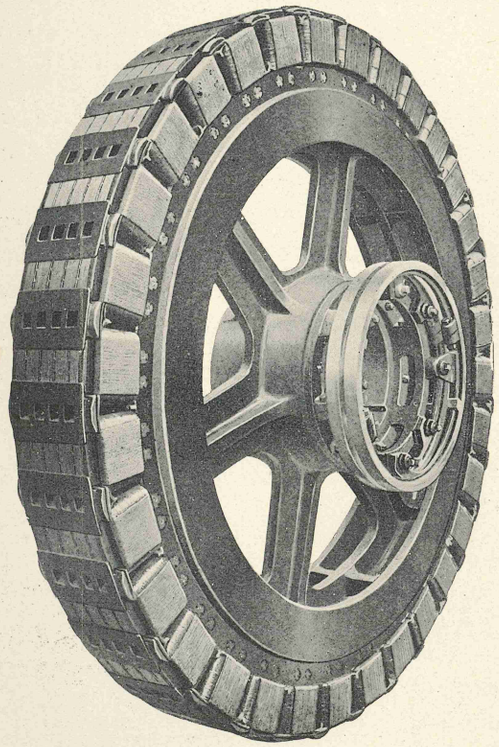
Spider Type Collector

Armature—Slotted soft steel punchings built up into a ring are accurately dovetailed within a cast iron frame and held firmly in position between steel end plates. The armature coils are formed of wire, strap or copper bar according to size and voltage. For alternators of high potential and low current capacity, machine wound coils of wire are usually employed. For lower potentials and heavier current the winding is formed of copper strap bent into the required shape, and insulated, after forming, with sheet material of the highest quality applied in overlaping layers and held in place by taping. The completed coil is coated with an especially prepared moisture and oil proof compound. The coils thus insulated are so gauged that they slip easily into slots in the armature core without distortion of any kind, thus minimizing the danger of injury to the insulation. With the open type of slot retaining wedges of hard fibre hold the coils in exact position. These wedges may be pressed out at will and the coils readily removed. In many of the larger machines of 220 and 440 volts the coils consist of carefully insulated copper bars placed in partially closed slots and held in position by the overhanging lips of the armature teeth. Suitable end connectors unite the bars into a common winding. Any bar may be removed without interfering with the others. On large machines of high voltage and on small machines of 1100 volts and above, hand winding in partially closed slots can often be used to advantage.



Strap Wound Field Coil Ready for Insulation

Ventilation—Open spaces in the laminated field rings, registering with corresponding spaces in the core of the stationary armatures, provide passageways for the free circulation of air. During operation air is drawn in through suitably formed openings in the field spider and forced out through the open spaces, thus dissipating the heat of the core and coils and insuring a low operating temperature. The ventilated field poles, a feature found only in Westinghouse generators, are shown in the illustration on this page. The collector rings are also so constructed that air circulates freely about them. The diagram on opposite page indicates the method by which this thorough ventilation is secured and illustrates the care with which all details have been worked out in the design of this apparatus.

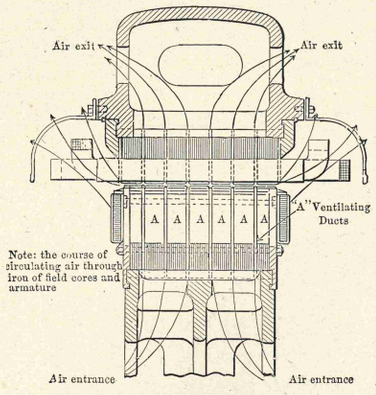


Revolving Field Showing Ventilated Poles and Dampers

Regulation—Many users of electrical machinery apparently fail to appreciate the prime importance of close regulation. In the effort to secure high efficiencies, low temperature rise and maximum capacity for a given amount of material this feature has often been sacrificed. The excellent regulation shown by Westinghouse alternators is obtained by properly proportionating the armature and field windings.

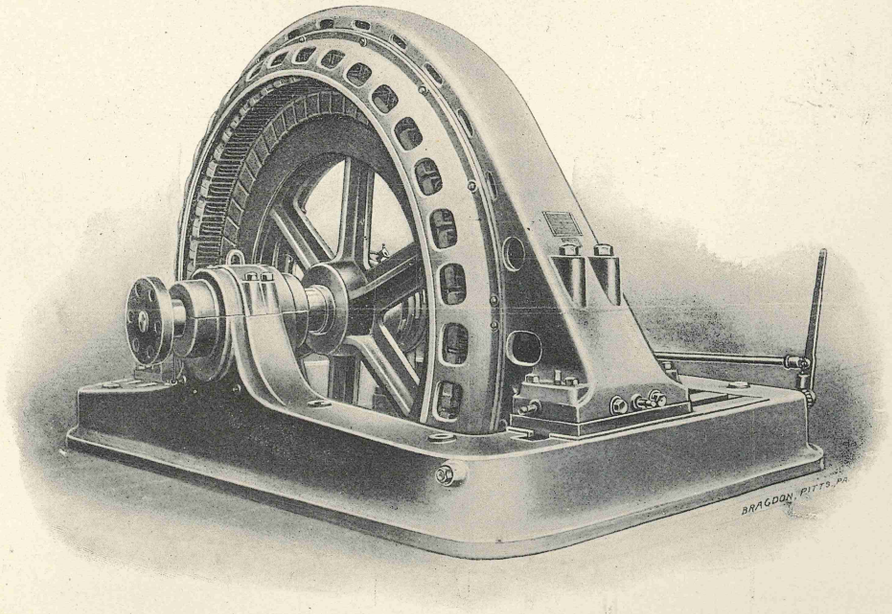
Unequaled facilities for manufacture, skilful design, and the knowledge which comes only from long experience combine to make these generators all that can be desired, both in construction and performance.

Westinghouse generators are noted for their large reserve capacity and their ability to carry the heavy overloads which are often unavoidable, and the severe service due to loads of low power factor.

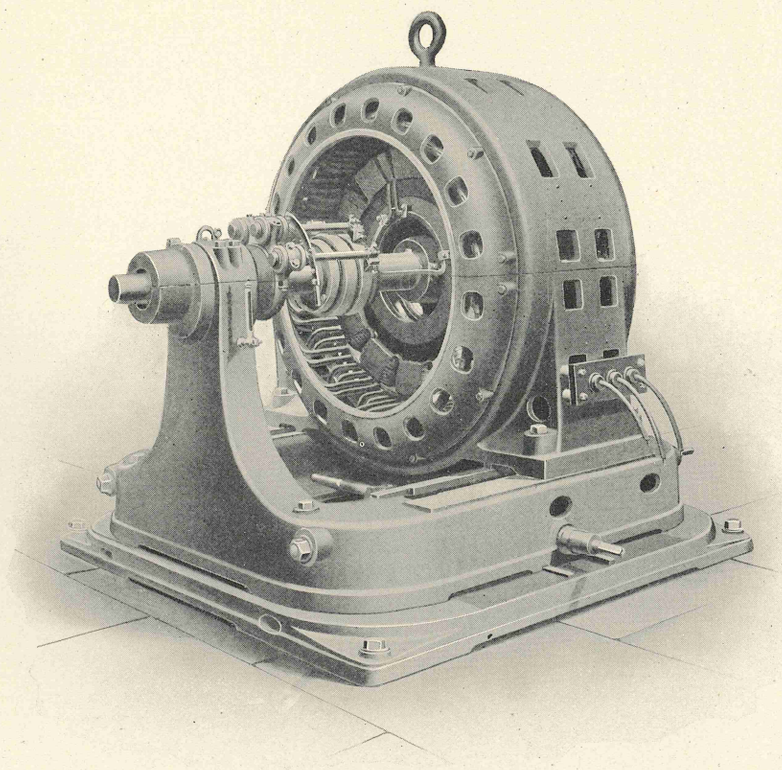


Cross Section Through Field and Armature Showing Ventilating Ducts

The alternating current polyphase system has not only proved its value in the transmission of power over long distance and in electric service from large central stations, fields exclusively its own, but has repeatedly demonstrated its superiority as an economical and efficient method of distributing power in workshops and factories of every description. It is used with great success in the operation of cranes, hoists, and similar apparatus, requiring a variable speed as well as the more numerous class of constant speed machinery.



400 K.W. Two-Phase, 6000 Volt, 60 Cycle Revolving Field Generator



TWO-BEARING REVOLVING FIELD ALTERNATOR THREE-PHASE

Revolving Field Alternators

7200 Alternations

Two-Bearing for Direct Connection

K.W.	Speed	Net Weight—Lbs.	K.W.	Speed	Net Weight—Lbs.
30	1200	2000	425	300	28000
50	900	4300	425	164	54000
75	720	5375	500	360	29000
100	900	5375	500	180	55000
120	720	7150	550	400	30000
150	900	7150	600	300	37500
150	450	8500	600	200	50000
180	514	8500	625	450	30000
200	600	8500	650	360	37500
250	450	17500	700	225	50000
300	514	17500	750	400	37500
300	300	21000	800	257	52000
350	257	28000	900	300	52000
400	400	21000	1050	360	52000
400	225	36000	1200	400	52000

Two-Bearing for Belt Driving

K.W.	Speed	Net Weight—Lbs.	K.W.	Speed	Net Weight—Lbs.
75	720	5900	150	450	9100
100	900	5900	180	514	9100
120	720	7700	200	600	9100
150	900	7700			

These machines are equipped with sliding base, belt tightener and pulley.

Three-Bearing for Belt Driving

K.W.	Speed	Net Weight—Lbs	K.W.	Speed	Net Weight—Lbs.
250	450	22500	425	300	38000
300	514	22500	500	360	39000
300	300	29000	550	400	40000
350	257	38000	625	450	40000
400	400	29000			

These machines are equipped with sliding base, belt tightener and pulley.

The above ratings apply to standard machines wound for 220, 440, 1100 or 2200 volts, two or three-phase.

Standard machines wound for higher voltages have slightly different ratings.

Revolving Field Alternators With Bearings

3000 Alternations

Two-Bearing for Direct Connection

K.W.	R.P.M.	Net Weight—Lbs.	K.W.	R.P.M.	Net Weight—Lbs.
30	750	2400	440	300	30000
50	750	5160	480	375	30000
50	375	5375	500	250	37000
60	500	5375	500	187	45800
65	750	5375	550	500	30000
70	300	7150	570	214	45800
75	375	7150	600	300	37000
90	300	8500	640	187	60000
95	500	7150	660	375	37000
100	750	7150	670	250	45800
115	250	16000	700	187	58000
120	375	8500	750	150	62000
135	300	16000	740	214	60000
150	500	8500	780	214	58000
180	214	21000	800	300	45800
185	375	16000	850	250	60000
200	750	8500	900	250	58000
225	250	21000	950	187	62000
230	500	16000	1000	300	60000
250	300	21000	1020	150	87000
275	375	21000	1080	214	62000
300	750	16000	1150	375	60000
300	214	30000	1200	280	62000
310	500	21000	1300	167	87000
370	250	30000	1450	214	87000
375	187	37000	1500	250	87000
430	214	37000			

Two-Bearing for Belt Driving

K.W.	R.P.M.	Net Weight—Lbs.	K.W.	R.P.M.	Net Weight—Lbs.
50	375	5900	100	750	7700
60	500	5900	120	375	9100
65	750	5900	150	500	9100
75	375	7700	185	375	17200
90	500	7700	200	750	9100

Three-Bearing for Belt Driving

K.W.	R.P.M.	Net Weight—Lbs.	K.W.	R.P.M.	Net Weight—Lbs.
230	500	22500	440	300	40000
250	300	29000	480	375	40000
275	375	29000	500	250	58000
300	750	22500	550	500	40000
310	500	29000	600	300	58000
370	250	40000	660	375	58000

The above ratings apply to standard machines wound for 220, 440, 1100 or 2200 volts, two or three phase.

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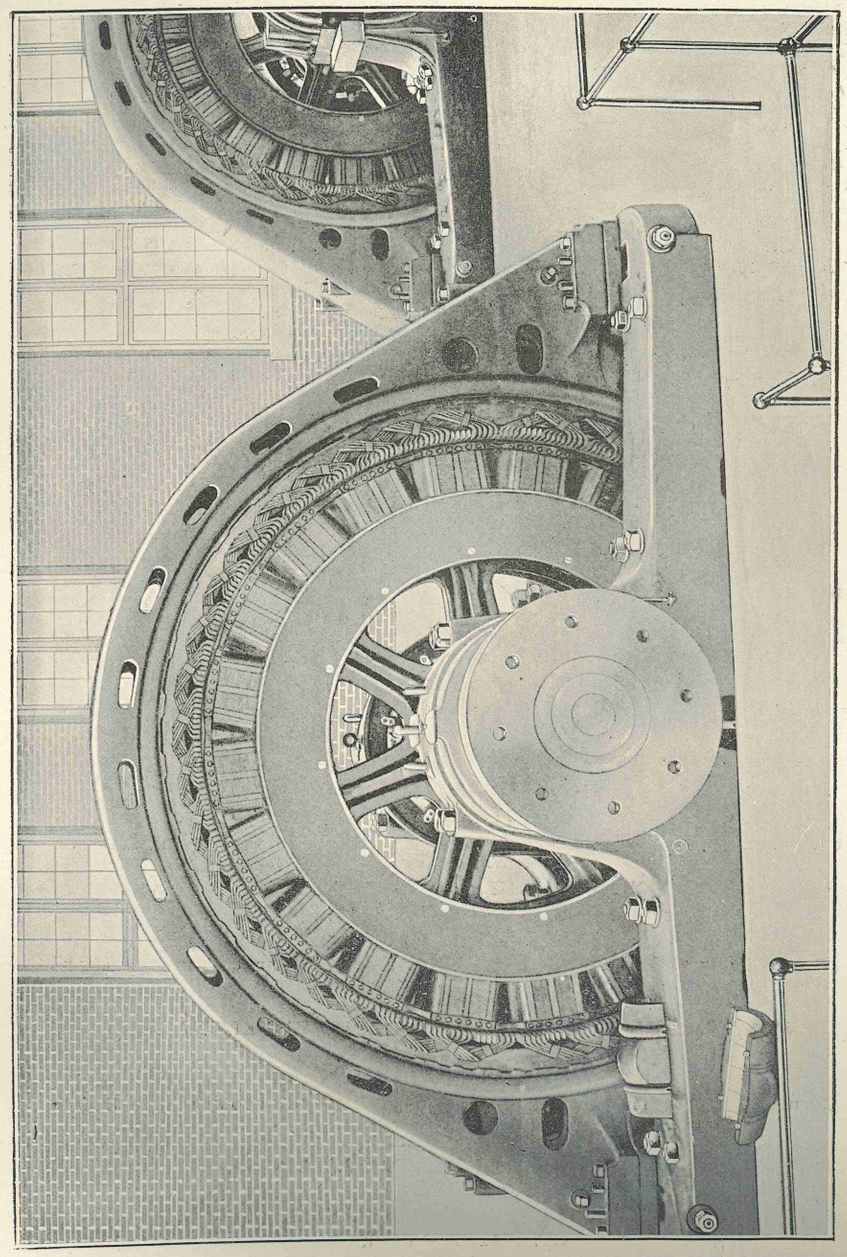

3750 K.W. Two-Phase, 2200-Volt Revolving Field Alternators
In the Power Station of the Shawinigan Water Co., Shawinigan Falls, Ont. (During erection.)

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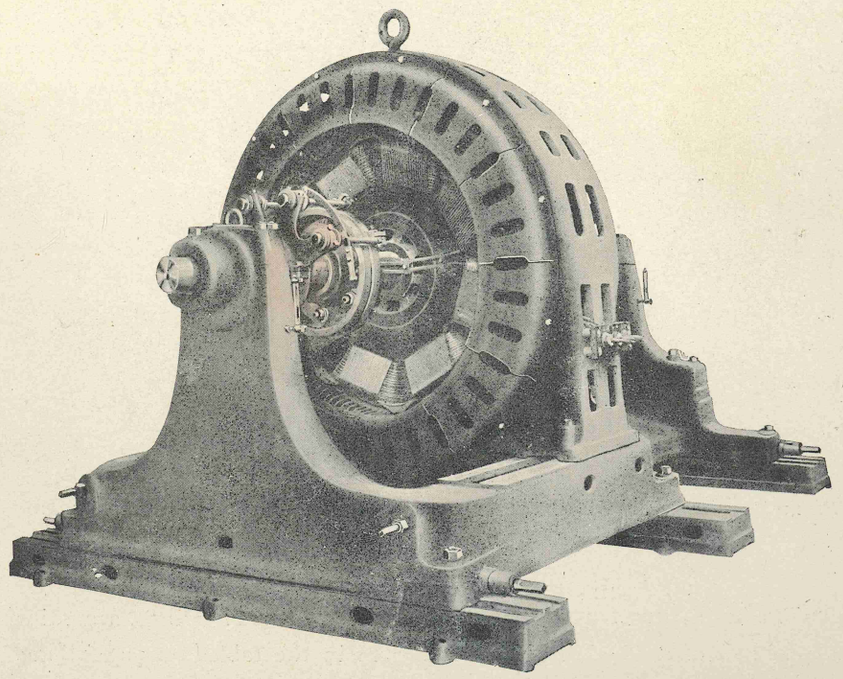

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